# Adoption and impact of dry-season dual-purpose cowpea in the semiarid zone of Nigeria

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# Adoption and impact of dry-season dual-purpose cowpea in the semiarid zone of Nigeria

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## Abstract

*In the semiarid region of West and Central Africa, farmers traditionally cultivate different cowpea varieties for grain and fodder. However, the grain yield potential and the availability of good quality fodder is limited by several factors: insects, pests and diseases, low and erratic rainfall, and the long dry season. In the early 1990s, the International Institute of Tropical Agriculture (IITA), in collaboration with the International Livestock Research Institute (ILRI), initiated a breeding program to develop improved cowpea varieties that produce both grain for human consumption and fodder for livestock in the dry season. This paper examines the patterns, levels, rate of adoption, and the impact of one of the most promising varieties (IT89KD-288) introduced to farmers in Kano State, Nigeria. The diffusion and uptake of this variety had been very impressive as it reached over 1500 farmers in 1997, only 4 years after its accidental release to one farmer. The results show that farmers derived substantial benefits from adopting dry-season dual-purpose cowpea. These include food security during a critical period of the year, cash income, crop diversification, fodder, and in situ grazing after harvesting, in periods when the prices of cowpea grain peak, and when good quality fodder is scarce. Dry-season dual-purpose cowpea is thus a profitable technology that will find economic and ecological niches in the mixed crop/livestock farming systems of the semiarid zones of West and Central Africa.*

**Key words:** Adoption, cowpea varieties, dry-season, dual-purpose, fodder, impact, Nigeria

## Introduction

Cowpea is of vital importance to the livelihood of millions of people in West and Central Africa. From its production, rural families derive food, animal feed, and cash income. It provides nutritious grain and an inexpensive source of protein for both rural poor and urban consumers. Cowpea grain contains about 25% protein and 64% carbohydrate (Bressani 1985) and therefore has a tremendous potential to contribute to the alleviation of malnutrition among resource-poor farmers. In addition, cowpea contributes to the sustainability of cropping systems and soil fertility improvements in marginal lands by providing ground cover and plant residues, fixing nitrogen, and suppressing weeds. Some cowpea varieties also cause suicidal germination of *Striga hermonthica*, a devastating parasitic weed of cereals. Hence, cowpea is an ideal crop for the semiarid regions of the tropics, where other food legumes may not perform well.

About 8 million ha of cowpea are grown in West and Central Africa, where the most important producers are Nigeria (4 million ha), Niger (3 million ha), Mali, Burkina Faso, and Senegal. In Nigeria, the production trend of cowpea shows a significant improvement with about 441% increase in area planted and 410% increase in yield from 1961 to 1995 (Ortiz 1998). Several factors account for these impressive increases. Over the last two decades, the International Institute of Tropical Agriculture (IITA) has made significant advances in improving the productivity of cowpea in sub-Saharan Africa. A number of varieties have been developed combining diverse plant type, different maturity periods, and resistance to several diseases, insect pests, and parasitic weeds, and possessing other good agronomic traits (Singh et al. 1997)

### *Development of dry-season dual-purpose cowpea varieties*

In the semiarid regions of Nigeria, cowpea fodder is an important resource for livestock. The aboveground parts of cowpea, except pods, are harvested for fodder. The take-off of cowpea fodder contributes to feed supplies for large and small ruminants. Traditionally, farmers cultivate two main types of cowpea: early maturing varieties grown for grain and late maturing varieties grown for fodder production. However, during the dry season, good quality fodder is scarce. Therefore, there was a need to develop dual-purpose varieties that would give reasonable grain and fodder yields, thereby maximizing the output from land and labor. The use of cowpea as a dual-purpose crop, providing both grain and fodder, is attractive in mixed crop/livestock systems where land and feed are becoming increasingly scarce (Tarawali et al. 1997) especially in the dry season. There is a potential for large-scale cowpea production during the dry season, using the existing irrigation facilities promoted specially to stimulate the production of

wheat in the area and residual moisture in wetlands and river beds (Singh and Blade, 1997).

In the early 1990s, IITA, in collaboration with the International Livestock Research Institute (ILRI), initiated a breeding program to develop dual-purpose cowpea varieties that produce both grain and fodder to suit the diverse needs of farmers in the semiarid region. A recent breakthrough in cowpea breeding was the development of dry-season dual-purpose cowpea varieties adapted to the conditions of the semiarid zone. These varieties are dual purpose because they provide grain for human consumption and fodder for livestock. Several dry-season cowpea varieties were evaluated in irrigated and wetland areas in on-farm dry-season trials. These varieties have potential grain yields of over 1 t/ha with fodder yields of 4–10 t/ha when planted at the end of January to mid-February (Singh et al. 1997). They are harvested near the end of April to mid-May, when prices for cowpea grain and fodder are high.

This study focuses on the diffusion and adoption of one of the most promising cowpea varieties, IT89KD-288. This is an improved local variety that combines resistance to aphids, bruchids, thrips, nematodes, and some viruses, which are the main constraints to cowpea production in the dry season. Fodder and grain yields of this improved variety are also higher than those of the local varieties. Data from farmers' fields showed that farmers obtained average yields of 1.3 t/ha of grain and 2.5 t/ha of fodder (Singh et al. 1997). The variety can be sown as late as 15 January–15 February and matures between April and mid-May, well before the onset of the rains. It is easily identified by its white seed and plant architecture with pods held over the canopy. It is thus expected that this dry-season dual-purpose variety would gain popularity among farmers in the semiarid regions of Nigeria.

However, the final test of these varieties is adoption by the majority of the small-scale farmers in the target area. The adoption of a new agricultural technology is important for evaluating the impact of agricultural research investments (Norton and Davis 1981; Jahnke et al. 1986; CIMMYT 1993; Collinson and Tollens 1994) and for guiding technology development to satisfy the needs of the clients. Technology adoption brings potential impact at the farm household level (Sanginga 1998). This paper presents the results of studies carried out to examine the patterns, levels, rates of adoption, and impact of dry-season dual-purpose cowpea varieties in the semiarid zone of Nigeria (Adesina et al. 1997; Inaizumi et al. 1997; Inaizumi 1998).

## Methodology

The study was carried out in Bunkure Local Government Area (LGA) of Kano State in northern Nigeria. Kano State lies in the semiarid zone of Nigeria, around latitude 11°34¢N and longitude 8°44¢E. The Sudan ecology is characterized by a growing period of about 100 to 150 days. Annual rainfall, between 500 and 1000 mm, is erratic and restricted to 4 months.

The survey was carried out in three villages (Dandagana, Lautaye, and Gabar Da Gari) of Bunkure LGA, where dry-season dual-purpose cowpea had been introduced to farmers though on-farm participatory evaluation trials. Data were collected from a sample of 599 farmers in these villages (448 adopters and 151 nonadopters) using a structured pretested questionnaire. The questionnaire collected data on farmers' socioeconomic characteristics, cropping systems, varietal adoption, diffusion process, and benefits and constraints of dry-season dual-purpose cowpea.

## Results and discussion

### *Socioeconomic characteristics of sampled farmers*

Most households in the region were Muslim, and women generally did not participate in agricultural activities beyond threshing and food processing in the home. The majority of farmers were middle-aged. About 80% of respondents had fewer than five children. Educational levels were generally low. The majority of farmers in Dandagana and Gabar Da Gari had had more than 5 years of Koranic education, while a considerable number of farmers in Lautaye had had more than 6 years of western education. About 80% of farmers had had more than 20 years' experience in cowpea production. However, 40% of adopters in Gaba Da Gari had a relatively short experience of cowpea production, averaging less than 5 years, compared to 20 years for the majority of nonadopters.

The distribution of respondents according to their farm size showed that the majority of farmers were small-scale farmers with less than 1 ha of cultivated land. Land pressure was more pronounced in Gabar Da Gari, where 84% of farmers had less than 0.25 ha of arable land and only 9% had 0.5 ha or more. Similarly, in Dandagana, 95% of farmers cultivated less than 0.5 ha. In Lautaye, land pressure was relatively moderate with 60% of farmers cultivating less than 0.5 ha, while 14% had more than 1 ha of arable land.

Cereals and grain legumes dominate the farming system in the study area, millet, sorghum, and cowpea being the major crops. Livestock rearing is very important in the region and the production of fodder is a significant source of income.

**Table 1. Percentage distribution of main crops cultivated by respondents in wet and dry seasons, 1997**

| Crop | Dandagana (n = 56) | Lautaye (n = 56) | Gabar Da Gari (n = 39) |
|---|---|---|---|
| **Wet season** | | | |
| Rice | 97 | 83 | 100 |
| Sorghum | 97 | 84 | 92 |
| Millet | 90 | 84 | 90 |
| Maize | 82 | 84 | 98 |
| Cowpea | 98 | 99 | 84 |
| Vegetables | 57 | 43 | 31 |
| Cassava | 45 | 36 | 10 |
| **Dry season** | | | |
| Wheat | 16 | 39 | 64 |
| Maize | 67 | 68 | 25 |
| Tomatoes | 79 | 80 | 33 |
| Pepper | 77 | 65 | 8 |
| Onion | 78 | 73 | 18 |
| Vegetables | 68 | 30 | 0 |
| Cowpea | 71 | 81 | 63 |

n = number of respondents.

Two major cropping seasons characterize the study area: the rainy season starting in April and ending in late October and the dry season starting in November and ending in April. Table 1 shows the percentage distribution of main crops cultivated by respondents in the two seasons. In the rainy season, major crops include cowpea, sorghum, rice, millet, maize, vegetables, and, to a lesser extent, cassava. During the dry season, farmers use irrigation facilities and the residual moisture of wetlands to cultivate pepper, tomatoes, onions, and maize. Irrigation schemes were established to encourage local production of wheat, which is in high demand for import substitution. Cultivation of wheat was more common in Gabar Da Gari (64% of farmers) than in Lautaye (39%) and Dandagana (16%). Cowpea cultivation is emerging as a new opportunity for dry-season farming. The next section discusses the diffusion and adoption profiles of dry-season cowpea in the three villages.

### *Diffusion profiles of dry-season dual-purpose cowpea varieties*

With the establishment of an IITA station at Kano in 1989/90, scientists saw the need for a suitable cowpea variety for the dry season. Farmers normally grow

wheat and vegetables during the dry season, but in some fields, wheat sowing is often delayed beyond 15 December due to the late harvest of rainy-season crops and unpredictable vegetable prices. Therefore, farmers wanted a more dependable and consistently profitable alternative crop for the dry season. IITA started to evaluate improved cowpea varieties in the dry season for this purpose at Wudil and Kadawa from 1991 in collaboration with the Hadejia Jamaare' River Basin Authority and the Kano Agricultural and Rural Development Authority. Some of the cowpea varieties yielded up to 1.9 t/ha grain and over 3 t/ha fodder. Planted from the middle to the end of January, these varieties matured by mid-April and were harvested before May, well before the onset of rains. Farmers were invited to see the trials during field days. After one of these field days at Wudil in April 1993, one of the farmers took, without permission, 200 g of seed from the border rows of an improved variety (IT89KD-288). The farmer multiplied the seed in the 1993 rainy season (August–November) at Bunkure, and together with six relatives and friends, planted this variety in the next dry season in January 1994. The following year, 47 farmers were growing the variety. This number increased to about 230 in 1996 and to over 1500 in 1997. From 200 g of seed in 1993, the production was expected to be over 200 t in 1997.

One of the critical issues in the diffusion of innovation is the role of information and seed exchange between farmers. Although the extension service has been the traditional channel through which seed is distributed to farmers, this variety has spread mainly through farmer-to-farmer horizontal diffusion. Survey results show that most farmers received information and first seed from other farmers in their villages. However, about 40% of farmers relied on direct purchases in the market for seed acquisition. In the three villages, farmers' seed exchange network systems have become more important in varietal diffusion.

The results also show that about 40% of farmers in Dandagana received information about IT89KD-288 in 1993. In Gabar Da Gari, farmers became aware of the variety in 1994, while the majority of the farmers in Lautaye (60%) received information on the variety relatively late in 1996.

### *Rates of adoption of dry-season dual-purpose cowpea varieties*

The rates of adoption, that is, the proportion of farmers cultivating dry-season dual-purpose cowpea in 1997, only 4 years after the introduction of the first variety by one farmer, were very impressive. Out of the 599 farmers surveyed, 448 (75%) had adopted dry-season dual-purpose cowpea varieties. Adoption rates were highest in Lautaye (81% of adopters), followed by Dandagana (71%), and Gabar Da Gari (63%). The most popular variety among virtually all adopters in the three villages was IT89KD-288 (Dandagana, 99%, Gabor Da Gari, 97%, and Lautaye, 71%). Figure 1 shows the cumulative rates of adoption of IT89KD-288 by

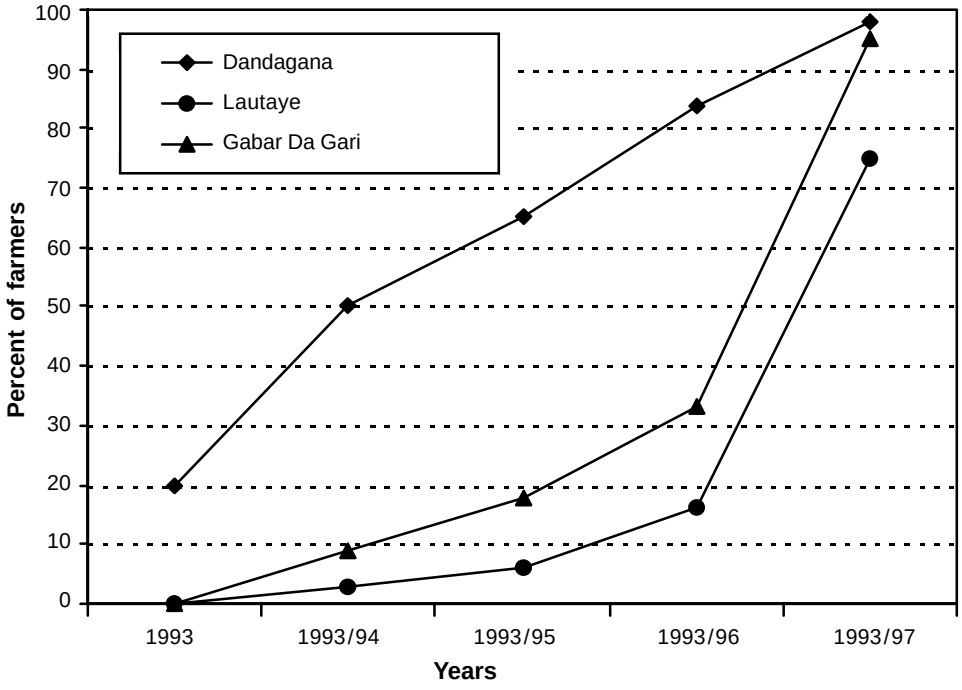


**Figure 1. Cumulative rates of adoption of IT89KD-288 dry-season dual-purpose cowpea varieties in the survey villages, Kano State, Nigeria (n = 136 for Dandagana, 245 for Lautaye, and 67 for Gabar Da Gari).**

village location of the growers.

The levels of adoption of the variety IAR-48 (Institute for Agricultural Research, Ahmadu Bello University) were limited in Dandagana (6%), and nil in Gabar Da Gari where 97% had adopted IT89KD-288. In Lautaye, however, about 43% of farmers were using the variety IAR-48. These adoption rates, strikingly different between the two varieties, were explained by the farmers' preferences for seed color. The white-seeded IT89KD-288 is preferred for local consumption and easy marketability in local markets; IAR 48 is brown seeded. Brown cowpea is not consumed in northern Nigeria and is only produced for markets in the south. IAR 48 recorded higher adoption rates in Lautaye because local marketing agents purchased the seed directly from farmers for transportation to southern Nigeria. These findings suggest that market access is important in farmers' adoption of new varieties, and corroborate recent findings that access to market and farmers' perceptions of varietal characteristics are critical in driving farmers' adoption behavior (Adesina and Baidu-Forson 1995; Adesina et al. 1997; Sanginga 1998).

These results clearly show that there has been a rapid growth in the diffusion of improved varieties, and that the level of intensity of use of dry-season dual-purpose cowpea has increased significantly. Figure 2 shows the evolution of

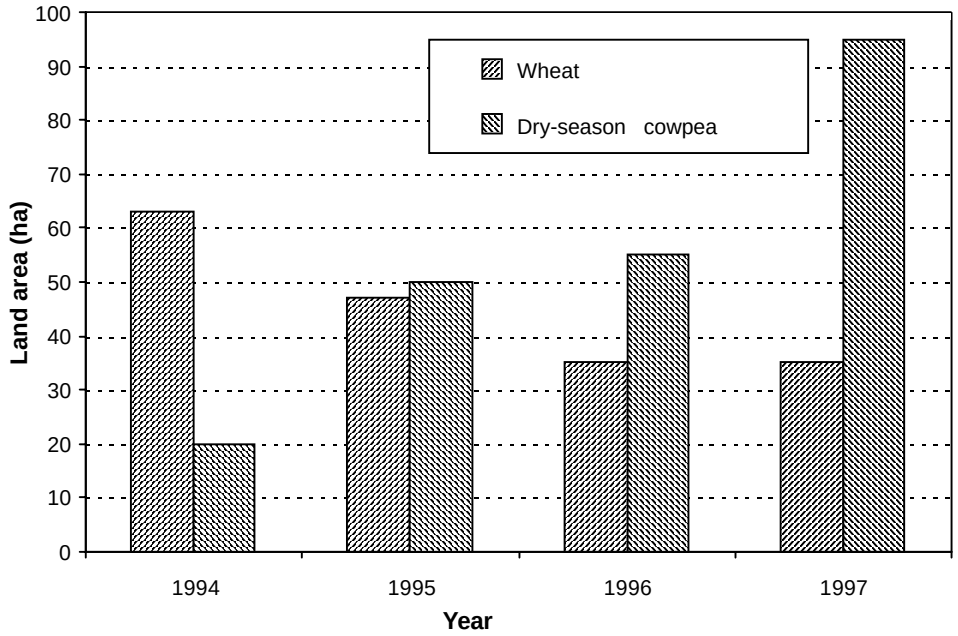


**Figure 2. Comparative evolution of land area cultivated to wheat and to dry-season cowpea in the survey villages (1994–1997).**

land area cultivated to dry-season dual-purpose cowpea compared to that for wheat in the three survey villages. In 1994, wheat occupied a total of 39 ha, while dry-season cowpea was grown on 18 ha. In 1997, the area cultivated to wheat had decreased by 235%. Conversely, the area planted to dry-season dual-purpose cowpea had increased dramatically by about 452% during the same period in the three villages. Farmers explained that dry-season dual-purpose cowpea had replaced wheat mainly because the fertilizer required for wheat was no longer affordable. Dry-season dual-purpose cowpea did not require any fertilizer to produce acceptable yields. Other important constraints to wheat production include lack of machinery, insufficient water supply, high labor demand during planting, and late maturity compared to cowpea.

### *Constraints to adoption of dry-season dual-purpose cowpea*

The major constraints to the adoption of dry-season dual-purpose cowpea include insect attack in the field and in storage, insufficient water, nematodes, lack of land, and lack of seed (Table 2). Nematodes were a major constraint to 84% of farmers in Lautaye and about 62% in Dandagana, but were not mentioned in Gabar Da Gari. IT89KD-288 is resistant to nematodes whereas IAR-48 is susceptible. Lack of seed was mentioned as a major constraint only in Lautaye by 65% of farmers. This was indicative of the relatively low adoption rates recorded in this area

**Table 2. Constraints to dry-season dual-purpose cowpea production identified by nonadopters (% of respondents)**

| Constraint | Dandagana (n =56) | Lautaye (n = 56) | Gabar Da Gari (n = 39) |
|---|---|---|---|
| Insect attacks | 80 | 65 | 81 |
| Lack of fertilizer | 75 | 58 | 74 |
| Insufficient water | 70 | 35 | 70 |
| Storage problems | 60 | 56 | 4.5 |
| Lack of seed | 3 | 65 | 0 |
| Nematodes | 62 | 84 | 0 |
| Lack of land | 24 | 53 | 3 |

n = number of respondents.

compared to other villages. These results suggest that there is a need to develop varieties that are resistant to nematodes and storage insects. There is also a need for an efficient seed multiplication and distribution system to improve farmers' access to improved varieties.

### *Impact of dry-season dual-purpose cowpea*

Farmers were asked to assess the impact of dry-season cowpea on their households. The majority of farmers indicated that cultivation contributed significantly to their household food security at the beginning of the rainy season when supplies of most foods were exhausted. As stated earlier, cowpea is an important staple food in the region. In addition to its contribution to the household food security at a critical period of the year, the crop provides farmers with income opportunities. Farmers reported that dry-season cowpea contributed immensely to their farming practices and economic status. The results in Table 3 show that farmers saw the cultivation of dry-season cowpea as a more dependable and profitable source of income than growing wheat and rainy-season cowpea. Dry-season cowpea provides good quality fodder at a period when fodder is scarce and

**Table 3. Farmers' assessment of benefits of dry-season dual-purpose cowpea (% of respondents)**

| Benefit | Dandagana (n = 136) | Lautaye (n = 245) | Gabar Da Gari (n = 67) |
|---|---|---|---|
| Profitability compared to wheat | 93 | 73 | 31 |
| Profitability compared to wet-season cowpea | 90 | 68 | 31 |
| Reduction in income risk | 5 | 53 | 12 |
| Provision of fodder | 81 | 16 | 3 |
| Reduction of labor | 10 | 51 | 12 |
| Reduced water problem | 10 | 41 | 1 |

n = number of respondents.

requires less labor and water than other crops.

Dry-season cowpea grain and fodder become available in late April/early May when prices peak and farmers are able to get maximum profit. Based on current prices (Table 4), a tonne of dry-season cowpea can yield a gross return up to N50 000/ha (N78 = US$1). Data from local markets show that the price of dry season cowpea grain was twice as high during the dry season than the price of cowpea and other cereal and grain legumes cultivated during the rainy season. Survey results show that the net profit revenue from the sale of cowpea was N12 662 per farmer.

Similarly, cowpea fodder prices in the dry season were three times higher than the price of fodder in the rainy season. The fodder was sold in situ after grain harvest for about N20 per bundle or N500 per hectare. Clearly, dry-season dual-purpose cowpea has increased the income level of farmers, as it provides about 25% of the farmers' total annual income. In some cases, cowpea was especially valued for fodder, which fetched a higher income than grain because households consumed most of the cowpea grain during this food-scarce season.

Several farmers also lease their cowpea fields to cattle herders for in situ grazing after harvesting the pods. In addition to the obvious economic benefits is the value of cattle droppings in the field. Thus, this system contributes to the sustainability of mixed crop/livestock farming systems in the semiarid region. The adoption of dry-season dual-purpose cowpea has helped to improve farmer/cattle rearer social interactions that contribute to the sustainability of the system through effective crop/livestock integration. Manure from livestock is returned to the field, and animals provide milk, meat, income, and traction for land preparation, weeding, and transport. Research results also show that cowpea fodder has higher nutritive values than many leguminous crops (Tarawali et al. 1997). Experimental results also show that supplementing village herds of Zebu cattle with 1 kg cowpea hay at

**Table 4. Market prices* of cereal and grain legume food crops and fodder in two rural markets in Kano, Nigeria, dry season (January–December 1997)**

| Crop | January | April | July | October | December |
|---|---|---|---|---|---|
| Sorghum | 23/21 | 48/48 | 60/62 | 50/35 | 40/40 |
| Millet | 25/24 | 50/50 | 65/67 | 45/45 | 48/45 |
| Cowpea | 40/38 | 90/85 | 95/93 | 70/55 | 65/60 |
| Groundnut | 30/28 | 80/70 | 86/80 | 75/60 | 80/60 |
| Cowpea fodder | 10/9 | 30/25 | 30/32 | 15/25 | 15/20 |
| Groundnut fodder | 7/5 | 20/16 | 30/26 | 20/25 | 20/15 |

*The prices are quoted in Naira per *mudu* or bundle. *Mudu* is a bowl used for grains in local markets. It is equivalent to about 2.5 kg. Fodder is sold in bundles, with approximate weights of 3.5 kg for cowpea and 2.4 kg for groundnut. Official exchange rate in Dec 1997 was N78= US$1.

night led to a weight gain of 95 kg in 7 months compared to 65 kg for the unsupplemented cattle, representing a difference of 67 g/animal/day (Schlecht et al. 1995).

Farmers also indicated that dry-season cowpea increased the choice of crops for cultivation in the dry season, making farming a year-round activity. Benefits of this include hunger alleviation, increased food supply, and increased economic base of the family. With the adoption of dry-season cowpea, it is now possible to have three crops in a year in some areas of the survey villages, while maintaining the sustainability of the system by changing the traditional cereal-cereal sequence formerly practiced by farmers. The cultivation of the new dry-season cowpea has created additional opportunities for employment from planting through harvesting, processing, and marketing of products. It has also increased labor productivity, particularly family labor, because there are few alternative work options in rural areas during the dry season.

## Conclusion

This study examined the adoption and impact of dry-season dual-purpose varieties of cowpea in semiarid Nigeria. The results show a rapid diffusion and adoption of these varieties in the villages surveyed. The diffusion of this variety occurred through one farmer who took 200 g of seed for observation and trial at his farm while trials were going on at the IITA station in Kano in 1993. The adoption of this variety was very impressive, reaching over 1500 farmers in 1997 (75% of farmers) only 4 years after its introduction to farmers.

The land area cultivated also increased dramatically (by 452%) from 1994 to 1997. The rapid spread of the dry-season dual-purpose cowpea variety among farmers suggests two important lessons for planning technology development and dissemination in the semiarid regions of Africa:

1. Resource-poor farmers are constantly in search of new opportunities to diversify their income source and to improve their well-being.
2. The development of technologies that have a comparative advantage in farmers' agroecological and socioeconomic conditions and provide them with new opportunities for income generation and diversification is of crucial importance. In the case of cowpea, scientists at IITA were able to develop a dry-season dual-purpose variety that permits farmers to exploit ecological and socioeconomic niches in the dry season when grain and fodder prices are high. It is not therefore surprising that the rates of adoption of this variety increased so much in a few years.

The experience from the diffusion and adoption profile shows that when a technology is appropriate, it stimulates an endogenous process of autodiffusion, through a dynamic farmer-to-farmer horizontal spread of planting materials. Rapid adoption of agricultural technologies by resource-poor farmers, such as the success of this cowpea variety, will require farmers' increased participation in the technology development and evaluation process in order to ensure that the technology would be appropriate to their needs.

The results also suggest that international agricultural research centers such as IITA can achieve substantial impact through a dynamic farmer participatory approach to technology development, dissemination, and evaluation. However, to speed dissemination and widespread adoption in other areas, there is a need to involve national agricultural extension services and nongovernmental organizations as well as the private sector making seeds and planting materials available to a larger number of farmers.

The results show that farmers derived substantial economic and social benefits from adopting dry-season dual-purpose cowpea. In addition to obvious nutritional and food security benefits, farmers derive a substantial cash income from the sale of cowpea grain, fodder, and in situ grazing after harvest, when the prices of cowpea grain are at their peak and good quality fodder is scarce. This dry-season dual-purpose cowpea has had a considerable impact on the weight of cattle supplemented with cowpea fodder, with reciprocal benefits for soil fertility improvement and sustainable crop/livestock integration in the semiarid region.

However, there is a need for more research to assess and quantify the actual impact of the adoption of dry-season dual-purpose cowpea on farmers' welfare, nutritional status, gender relations, soil fertility improvement, crop/livestock integration systems, and other socioeconomic and ecological variables.

There are great prospects for the adoption and impact of dry-season dual-purpose cowpea to alleviate poverty and malnutrition, and to contribute to the sustainability of African farming systems through profitable crop/livestock integration. Indeed, in many parts of the savanna zone of sub-Saharan Africa where livestock is important, cowpea is also an important niche crop in the farming systems. In many parts of West and Central Africa where the provision of food and livestock feed continues to be a serious problem for resource-poor farmers, dry-season dual-purpose cowpea will easily find a niche. Additionally, the development of irrigation schemes in some areas and the general increased use of wetlands (inland valley systems and fadamas) will also aid dual-season cowpea. The diffusion and adoption of dry-season dual-purpose cowpea will definitely make an important contribution to diversifying farmers' income opportunities, improving household food security and livestock feed supplies, and promoting a

sustainable crop/livestock integration for the sustainability of farming systems in marginal regions of sub-Saharan Africa. There is no doubt that this technological innovation will further contribute significantly to the "silent food revolution" (Oritz 1998) in sub-Saharan Africa.

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## References

Adesina, A.A. and J. Baidu-Forson. 1995. Farmers' perceptions and adoption of new agricultural technology; evidence from analysis in Burkina Faso and Guinea, West Africa. Agricultural Economics 13: 1–9.

Adesina, A.A., H. Inaizumi, and B.B. Singh. 1997. Determinants of farmers' rapid adoption of improved cowpea varieties for dry season cultivation in northern Nigeria. Mimeo, IITA, Ibadan, Nigeria.

Bressani, R. 1985. Nutritive value of cowpea. Pages 353–360 *in* Cowpea: Research, Production and utilization, edited by S.R. Singh and K.O. Rachie. John Wiley & Sons, New York, USA.

CIMMYT (Centro Internacional de Mejoramiento de Maiz y Trigo), 1993. The adoption of agricultural technology: a guide for survey design. CIMMYT, Mexico, DF.

Collinson, M.P. and E. Tollens. 1994. The impact of international agricultural research centers: measurement, quantification, and interpretation. Experimental Agriculture 30: 395–419.

Inaizumi, H., A.A. Adesina, and B.B. Singh. 1997. Determinants of rapid dissemination of improved dry season cowpea variety in northern Nigeria. Poster presented at the 23rd International Conference of Agricultural Economists, 10–16 Aug 1997, Sacramento, California, USA.

Inaizumi, H. 1998. Farmers initiative on technology dissemination–A case study from northern Nigeria. Proceedings of the Annual Conference of the Agricultural Economics Society of Japan, 2–3 Apr 1998, Chiba, Japan.

Jahnke, H.E., D. Kirchkle, and J. Lagemann. 1986. Impact assessment of international agricultural research centers. Agricultural Administration 22: 175–196.

Norton, G.W., and J.S. Davis. 1981. Evaluating returns to agricultural research. American Journal of Agricultural Economics 63: 685–699.

Ortiz, R. 1998. Cowpeas from Nigeria: A silent food revolution. Outlook on Agriculture 27(2): 125–128.

Sanginga, C.P. 1998. Adoption and social impact of agricultural technologies: The case of soybean in Benue State, Nigeria. PhD thesis, University of Ibadan, Ibadan, Nigeria.

Schlecht, E., F. Mahler, M. Sangré, A. Susenbeth, and K. Becker. 1995. Quantitative and qualitative estimation of nutrient intake and faecal excretion of Zebu cattle grazing natural pasture in semi-arid Mali. Pages 85–97 *in* Livestock and sustainable nutrient cycling in mixed farming systems of sub-Saharan Africa. Volume II. Technical papers, edited by J.M. Powell, S. Fernádez-Rivera, T.O. Williams, and C. Renard. ILCA, Addis Ababa, Ethiopia.

Singh, B.B. and S.F. Blade. 1997. Potential of dry season cowpea in West Africa. Pages 227–234 *in* Technology options for sustainable agriculture in sub-Saharan Africa, edited by T. Bezuneh, A.M. Emechebe, J. Sedgo, and M. Ouechaogo. OAU-STRC SAFGRAD, Ouagadougou, Burkina Faso.

Singh, B.B. and S.A. Tarawali. 1997. Cowpea and its improvement: Key to sustainable mixed crop/livestock farming systems in West Africa. Pages 79–100 *in* Crop residues in sustainable mixed crop/livestock farming system, edited by C. Renard. ICRISAT/ILRI/ CABI, Wallingford, UK.

Singh, B.B., O.L. Chamblis, and B. Sharma. 1997. Recent advances in cowpea breeding. Pages 30–49 *in* Advances in Cowpea Research, edited by B.B. Singh, D.R. Mohan Raj, K.E. Dashiell, and L.E.N. Jackai. IITA, and Japan International Research Centre for Agricultural Sciences (JIRCAS) copublication. Available at IITA, Ibadan, Nigeria.

Tarawali S., B.B. Singh, M. Peters, and S.F. Blade. 1997. Cowpea haulms as fodder. Pages 313–325 *in* Advances in cowpea research, edited by B.B. Singh, D.R. Mohan Raj, K.E. Dashiell and L.E.N. Jackai. International Institute of Tropical Agriculture (IITA), and Japan International Research Center for Agricultural Sciences (JIRCAS) copublication. Available at IITA, Ibadan, Nigeria.